PETRALOGY, OR THE KNOWLEDGE OF ROCKS AND STONES.*

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I shall hereafter have occasion to speak of alumine and potash, as being the characteristics of the soils produced under direct atmospheric influences, the vegetable soils, acted upon by the atmosphere; or of the ocean waters, generating the one or the other, and not of necessity in oceanic aggregates, as is demonstrated by the aggregate masses of primary qualities, such as sands, sandstone, limestone, marls, specles of porphyry, clennite, &c., but accidentally blended with many of the primary masses, by the carrying or percolating action of the waters. The sands of those vast desert regions which have been unaffected by these causes are wholly free from alumine or potash; and where the silifications, termed Egyptian jaspers, but which are common to the northern boundaries of Africa and Asia, having traces of potash in their composition: this is always produced by accidental mixture, from causes as above stated. In the older soils of Europe, the subtle distinctions of generation, reproduction, and change, lie more immediately beneath the surface discoveries of scientific men, nor can they be appreciated as truths, other than by travel and observation. Much of the strata and masses of rock of Great Britain is wholly free from these products, and it is always found that they are disposed in what is termed secondary formations, disappearing as the lower beds become more homogeneous in their qualities. The lowest red sandstones, termed primary, consist of quartz only, but the secondary beds consist generally of quartz, felspar, clay, mica, and carbonate of lime; yet, notwithstanding this manifest difference in the composition of the upper and lower beds, it is far from being a demonstrable truth that they were formed under different epochs; for the ocean bed is the general recipient of all matters carried therein by rivers and moving bodies of water, and thus the lower beds, anciently as in the present epochs, were very often of mixed qualities, the beds of sand becoming the recipients of numerous compounds deposited therein. In proof of this, we have only to look at those regions where the ocean becomes the depository of mighty rivers; and here, in the season of floods, the earths are carried down into and are distributed over thousands of square miles of the ocean bed. Thus, the vast quantities of timber and carbonaceous matters deposited in one locality give birth to the mineral coal, in its varieties of marl and clay, all of which are contemporaneously producing and produced; and were the sea suddenly thrown off these regions, the multiplicity of phenomena would rather puzzle a modern geologist, who looks for an epoch of time in every variety of consolidated matter. Even in this country the existence of bones of extinct animals, and the vast heaps of fossilized or mineralized plants, while they are the unerring evidence of tropical influences, cannot be considered undeniable evidence of their having succeeded the coral formations and other phenomena generated under the like temperature, for the one and the other, united and uniting together, contemporaneously exist, and are generating or produced at the present day.

The act of cohesion of particles and aggregates, whereby they become one consolidated mass, is observable in all countries, and is not confined to the compound silica alone; for alumine, iron, and other neutral bodies, under certain forms, possess the like powers, and, regardless of the laws of affinity, silica, like water, is capable of embracing within its volumes, numerous compound bodies without any immediate changes taking place in their atomic constituents, and having assumed the consolidated state, it possesses greater power of resistance to atmospheric action than any other earth. To effect sensible changes within its prescribed medium, it is absolutely necessary that other elemental compounds be blended with it, or that it be acted upon by chemical affinities, otherwise, it remains constant to the form assumed through a series of generations; in fact, so long as it is preserved from chemical action. Silicified rocks maintain their individuality; but strata, varying from each other in ingredients, but having the common basis or cement, very readily unite as one whole: thus, granite is often observed to run into gneiss, and even into crystalline limestone. Again, pebbles and smaller aggregates, united with calcareous matter and some iron, readily unite as the calcareous matter becomes silicified. In the Nubian deserts, vast aggregate masses of this kind may be observed in all their stages of transition into species of jasper, the general chain of effects being palpably manifest to the senses. Changes like these are common in this country in beds of earth or clay containing lime or iron; these latter are the conductors of electric matter into the otherwise almost impervious clay; and the electric matter, abstracting the hydrogen from the clay, causes it to indurate as a siliceous body, or as clay-slate, the lime becoming converted into calc spar, which sometimes embraces portions of the earths affected by this action, or otherwise, varieties of iron-stone, pyrites, &c.

It is a maxim laid down by modern geologists "that science must study the laws of phenomena only, and never their mode of production." The absurdity of this dogma is self-evident, when we reflect that the laws which govern change extend to the very fountain-head from whence all human knowledge is derived; the matter and the action, and the local affections generated by local action, being indivisible, and producing the ultimate result or phenomena. The architect builds, but his labours are in vain, the material decomposes, and the stately fabric falls; he would ascertain the causes of decay, and he finds by the aid of chemistry that the decomposition of rocks is effected according to the chemical and mechanical conditions to which they are exposed; that these chemical affections depend upon the nature of their elementary compounds, and of the cement which binds them together; and that the mechanical effects are produced by rains, winds, heat, cold, gaseous exhalations, &c., of the nature of all which influences he must acquire some degree of knowledge ere he can proceed to apply a remedy. Again, chemistry leads him to pursue his inquiries still further, and to endeavour to understand under what conditions rocks were formed; he cannot stop at the knowledge that they consist of various undecompounded bodies chemically and mechanically united; but he would know why some are composed of quartz or silicious grains, as the sandstones, others of quartz and felspar, of quartz, felspar, and mica, and of hornblende, as trachyte, clennite, and granite; others of uniform bodies cemented by calcareous matter as the oolites, and others of earths, lamellated as the shales and clays: he is, therefore, of necessity led on to study their mode of production. Thus it is, in the absence of information, the present geological fabric is built upon the various speculations of inductive science.

Lord Bacon observes of the chemists of his day, "that they amend some things, but cause little advancement." The same remarks apply to chemists and geologists of the present day. The builder will find little to interest him in the mysticisms of this science, which are wholly inapplicable to practical purposes. Geologists tell him that all crystalline rocks are primary products existing prior to sands, pebbles, clays, and earths, these latter being produced by the decomposition of rocks. There are few, I believe, who have had occasion to use the almost indefinitely varied material of these consolidated substances, who are not capable of disproving this assumption, for a very extensive class of the crystalline rocks exhibit by the nature of their calcareous, siliceous, and argillaceous earths, their organic origin, and the laws by and under which they were produced. The limestone series embrace within their composition species identified with or analogous to existing species of the ocean, and sometimes the relique of land animals; in some species these animals, previous to the aggregate mass crystallizing, have wholly decomposed, but the elementary constituents remain, and furnish equally decisive proof of their primary origin. Again, we observe ocean marles, madrepore structures, and beds of molluscs, continually passing through these changes, the organic body decomposing, and the earths produced by this decomposition consolidating into limestone rock. Again, in the crystalline structure of granite we do not readily perceive traces of organic species, but microscopical observations have recently assured us that many of these crystalline bodies are wholly composed of infusoria. The sands upon the shores of this country, uniting with the shelly coverings of molluscs, may be often observed agglutinating together, and these sands are chiefly silica, the animal and vegetable matters uniting with them are chiefly silica, and this particular earth forms the general cement of the whole body; at first simple agglutination only, takes place; by degrees the union becomes more perfect, but the shells yet preserve their primary condition, they at length silicify or change in their nature; and, when the change is complete, we have a siliceous aggregate mass. But the change does not rest here, the aggregate gradually crystallizes, and the bodies forming that aggregate crystallize independently of each other; for the crystalline result varies in nature and qualities in many bodies thus united together, although the entire mass is ever governed in disposition and crystalline structure by the force of lateral pressure of the surrounding particles. Much of the strata of this country is composed of siliceous pebbles, and a great portion of those pebbles and petrified organic bodies, which, under the form of common flint, maintain the form characteristic of the species to which they belong, as sea-eggs, mussels, limpets, and other crustacea and molluscs; the bones, teeth, and vertebræ of fishes; the bones and fragments of land animals, and portions or entire trunks of trees: but uniting with these fossils are vast numbers of pebbles of the same siliceous nature, and by microscopical observation and analysis betoken the one common origin: yet men of science, while they embrace the former as fossils, designate the remainder, which are in general no other than the fragments or particles of the like organic species, as mineral bodies derived from the disintegrated rock. Again, clays exhibit innumerable traces of organization; we find aluminous clay producing from the union of the sea-water with matters deposited by running streams, which are chiefly vegetable earth. Again, subject to change produced by change of temperature, we see them pass into the state of clay-slate, or uniting with metallic matters becoming crystalline, and assuming the varied forms of rock.

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METROPOLITAN IMPROVEMENTS.*

THAMES EMBANKMENT.

The objections to the plan, however, on other grounds are not so easily disposed of. According to the evidence before the commission, the abstraction of the tidal water from a navigable river is in principle objectionable, inasmuch as it diminishes the efficacy of the scour. Various opinions were offered as to the degree to which this objection would apply to Mr. Walker's embankment. Mr. Hartley was of opinion that it would be considerable; and, with Mr. Giles, that its effects, if not felt in the Pool itself, would be more or less injurious in the district of the river below the Pool: Mr. Rennie, that it would operate both in the Pool and in the river below the Pool. The general tendency of these opinions, indeed, in reference to the plan immediately before us, was that, assuming the navigable current to be improved by judicious dredging, and a uniform course and increased velocity to be given to its channel, the loss would, in great measure, be compensated. But these opinions were given in reference only to a small portion of the river, irrespectively of any system for its general management, and, of course, without contemplating that extension of its present plans which this commission may feel it right to recommend hereafter.

It was objected as to the recesses, that in proportion as they were favourable to the trade, they would become injurious to the navigation. Mr. Hartley was of opinion that they would abstract from the full force of the tidal current, and in a limited or proportionate degree affect both the tide and the scour: Mr. Cubitt, that an embankment so formed would not be continuous enough above low-water mark to form a good and efficient tide to the river: Mr. Gordon, that by causing eddies,

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